Research Article

Effects of some primary and micronutrients on yield of rice (*Oryza sativa* L.) under Terai situation of West Bengal (India)

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Summary

An experiment was conducted with rice (cv. GOTRA BIDHAN - 1) in soils of Terai alluvial situation of West Bengal during the *Rabi* season of 2009-2010 to find out the effect of some primary (N-P-K) and micro (Zn-B) nutrients along with organic matter on the variability of yield of rice. The treatments were based on the soil-test based fertilizer recommendation . The average grain and straw yield of rice varied from 2.28 to 4.31 t ha^{-1} and 3.12 to 4.67 t ha^{-1}, respectively. Maximum grain yield of rice was obtained at the optimum application of the given nutrients. Omission of nutrients from the optimum, caused yield losses from 9.9 to 47.1 per cent. The yield data also revealed that N-P-K-Zn and B were the main limiting factors under the present experimental set-up. The results suggested the need for applying the given nutrients at optimum levels for the successful yield maximization programme.

Key words : Rice, Nutrients, Optimum levels, Yield maximisation

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Introduction

Soils of the Terai alluvial zone are deficient in several plant nutrients. Soil samples analyzed from the districts of Jalpaiguri, Cooch Behar, Uttar Dinajpur and Dakshin Dinajpur under Teesta-Terai alluvium of West Bengal (India) showed that nearly 80 per cent of soils fall under the low to medium category of N and K, while 60 per cent of soils are low to medium in P (Ali, 2005). Availability of P and B are among the important nutrient-related constraints in these soils. Fixation of applied P by Fe and Al oxides and hydroxides is a common problem that hinders uptake of P by crops. Deficiency of B in these soils is well recognized. Light textured soils and high rainfall (3,000 mm/year) in the region are contributing factors for B deficiency and most crops show distinct response to B application in these soils (Shukla *et al.,* 1983 and Saha, 1992). For rice, the major elements like C, H, O, N, P, K, Ca, Mg and S, are needed by plant relatively at a higher amounts than the minor elements, Fe, Mn, Cu, Zn, Mo, B and Cl. Based on the above perspectives the present work was undertaken to find out the effects of some primary (N-P-K), micro (Zn-B) nutrients and organic matter on the variability of yield of rice.

Resource and Research Methods

The field experiments were carried out with rice

(cv. GOTRA BIDHAN - 1) at the instructional farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar during the *Rabi* season of 2009-2010.The farm is situated at 26º 19'86"N latitude and 89º 23'53"E longitude and at an altitude of 43 meter above the mean sea level. The experimental design adopted was Random Block Design (R.B.D) in which there were ten treatments and each treatment combination was replicated thrice giving a total of 30 unit plots, each measuring 5m × 4m in area. The treatments were based on the soil-test based fertilizer recommendation of 130 kg N,65 kg P_2O_5, 65 kg K_2O,20 kg $ZnSO_4$ and 25 kg borax per ha. The first treatment (T_1) was optimum and the treatment from T_2 to T_6 were subsequent omission of N, P, K, Zn and B from the optimum, respectively. The treatment T_7,T_8 and T_9 were based on sole application of FYM (@10t/ha), State Recommendation (N:P:K:Zn:B=120:60:60:18:8 in kg/ha)

and farmers' practice (N:P:K:Zn:B=80:40:40:15:5 in kg/ha), respectively for rice. The untreated control was maintained at the treatment T_{10}.Uniform cultural practices and plant protection measures were used in all treatments. Harvesting of rice was done at the maturity in each plot and treatment wise yield was recorded. The soil and plant samples were analysed following the standard methods (Jackson,1973).

Research Findings and Discussion

The soil samples (0-0.15mt) collected from the experimental plots prior to the start of the experiment with rice (cv. GOTRA BIDHAN -1) were analysed to study the important physico-chemical properties. The soil was acidic in reaction (pH-5.85),the electrical conductivity (EC), cation exchange capacity (CEC) and oxidisable

Table 1 : Effect of nutrients on grain and straw yield of rice

Treatments	Yield (t/ha)	Y (t/ha)	% loss	Straw (t/ha)	Harvest index (HI)
T_1	4.31	-	-	4.67	48.00
T_2	3.80	0.51	11.8	4.18	47.63
T_3	2.65	1.66	38.5	3.15	45.71
T_4	3.37	0.94	21.8	4.15	44.83
T_5	2.47	1.84	42.7	3.25	43.20
T_6	2.86	1.45	33.6	3.36	45.97
T_7	2.35	1.96	45.5	2.99	44.01
T_8	3.88	0.43	9.9	4.61	45.70
T_9	3.65	0.66	15.3	4.36	45.57
T_{10}	2.28	2.03	47.1	3.12	42.21
C.D. (P=0.05)	0.05			0.15	
CV	1.046			2.3	

Y = Treatment wise yield difference from the optimum

Table 2 : Soil nutrient (kg/ha) status of rice at harvest

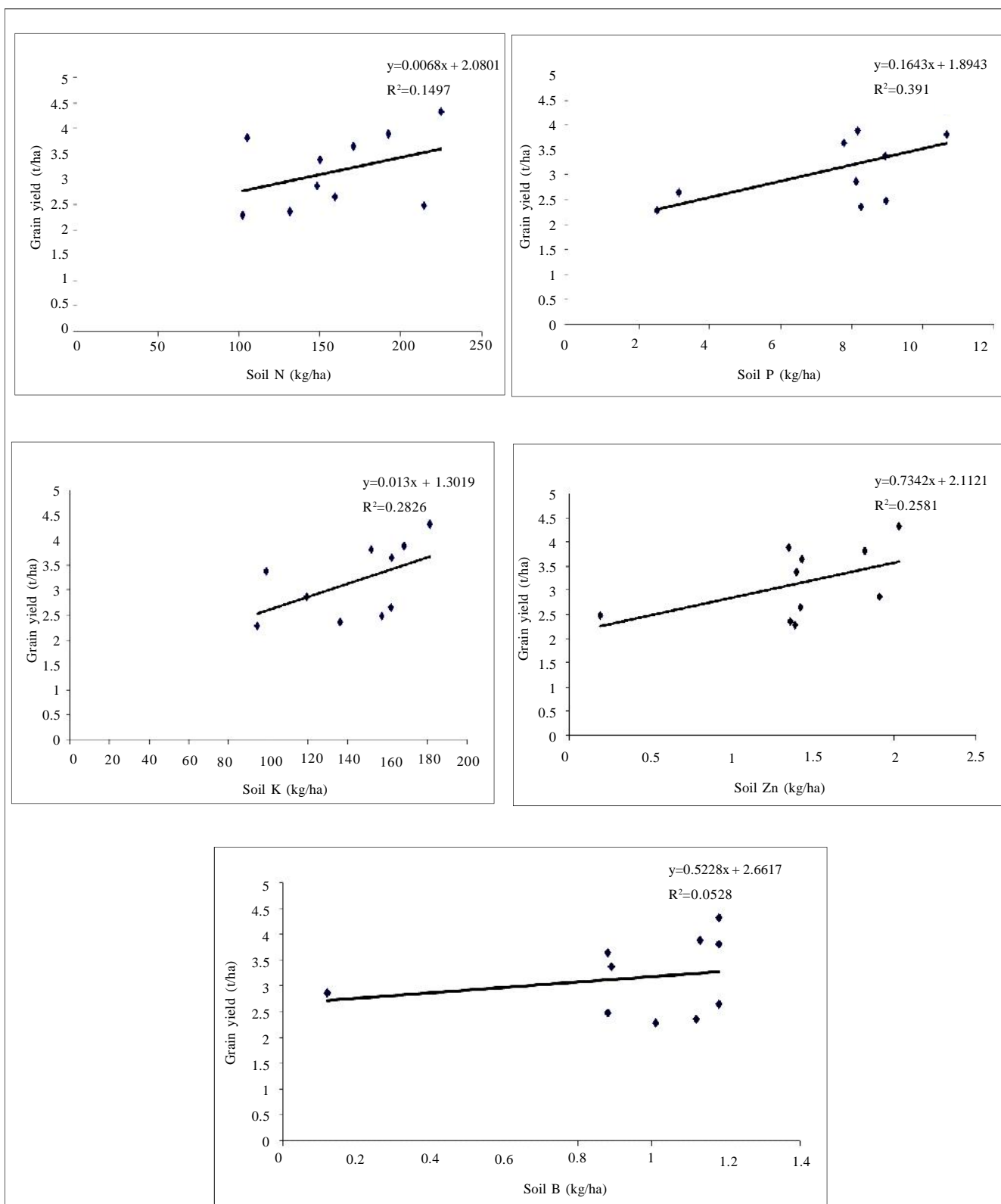| Treatments	N	P	K	Zn	B
T_1	224.57	10.65	181.31	2.03	1.18
T_2	105.23	10.68	151.97	1.82	1.18
T_3	159.06	3.12	161.91	1.42	1.18
T_4	150.01	8.94	99.01	1.40	0.89
T_5	214.29	8.96	157.29	0.19	0.88
T_6	148.26	8.13	119.35	1.91	0.12
T_7	131.36	8.25	136.01	1.36	1.12
T_8	191.99	8.17	168.35	1.35	1.13
T_9	170.74	7.78	162.33	1.43	0.88
T_{10}	102.27	2.50	94.46	1.39	1.01
C.D. (P=0.05)	0.027	0.026	0.059	0.011	0.0094
CV	1.21	3.617	1.378	6.07	5.404

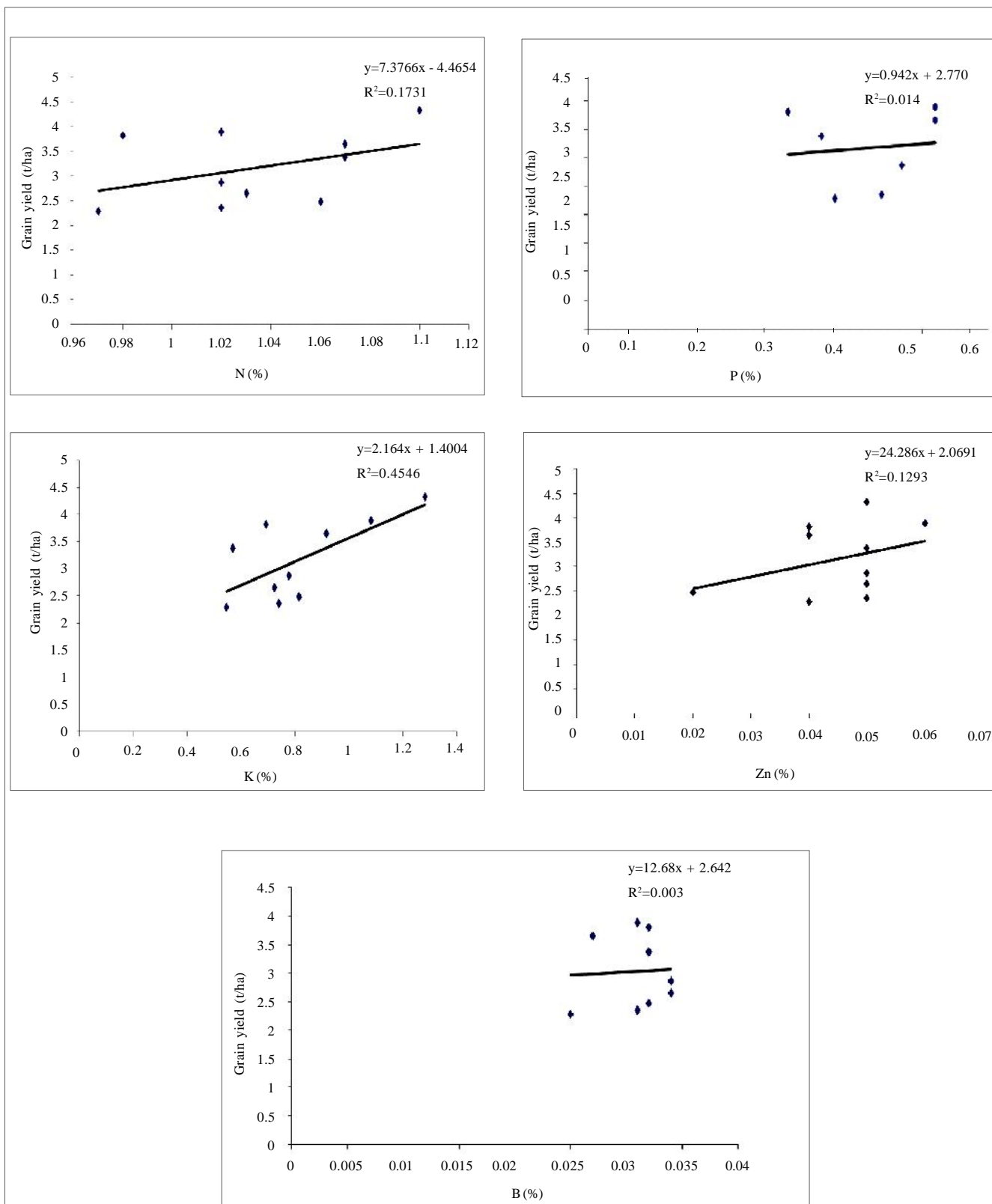Fig. 1:   Correlation between soil nutrients and grain yield of rice at harvest

Fig. 2 : **Correlation between plant nutrient content and grain yield of rice at harvest**

organic carbon were 0.05 dSm^{-1}, 3.97 cmol(p+) kg^{-1} and 1.16 gkg^{-1}, respectively. The average soil available N,P,K,Zn and B were 114.9,27.8,59.9,0.42 and 0.43 kg ha^{-1}, respectively. The soils were sandy loam in texture with 64.1 per cent sand,17.8 per cent silt and 19.1 per cent clay.

The average grain and straw yield of rice (cv. GOTRA BIDHAN -1) varied from 2.28 to 4.31 t ha^{-1} and 3.12 to 4.67 t ha^{-1}, respectively (Table 1). The maximum grain and straw yield of rice was obtained at the optimum application of the given nutrients (T$_1$). Omission of nutrients from the optimum caused yield losses that varied between 9.9 to 47.1 per cent (Table 1). It was observed that exclusion of N,P,K,Zn and B from the optimum caused comparable yield losses ranging from 11.8 to 42.7 per cent. The yield losses (45.5%) were relatively higher where only FYM (T$_7$) was applied and maximum at T$_{10}$ (47.1%) where the plants were allowed to grow on the native nutrient status of the soil. It was apparent that the applied FYM was unable to supplement the required nutrients to crop without N-P-K. Hence, combined application of FYM along with N-PK could have given better yield of rice (Acharya et al., 1998). The significant difference in yield was observed among the optimum level of application of nutrients (T$_1$), State recommendation (T$_8$) and farmers' practice(T$_9$) (Table 1). The relatively better yield was observed among the treatments T$_1$,T$_8$ and T$_9$ as for the inclusion of all the primary (N-P-K) and micronutrients (Zn and B) into the soil for the yield maximization of rice. The yield data also revealed that N-P-KZn and B are the main limiting factors under the present experimental set up.

The N-P-K-Zn and B status in soil at harvest (Table 2) showed the fractional build up of nutrients (N-K-Zn and B) in soil compared to the native status of the soil. A positive correlation was observed between the nutrient status in soil and grain yield of rice at harvest (Fig.1). A positive correlation was also observed between the grain yield and corresponding uptake (Fig. 2) by the crop. All these correlations suggested the interdependence of uptake of a particular nutrient on the other applied nutrients, which ultimately influenced the yield of rice

and the results also corroborated the importance of soil-test based nutrient application in rice. This is in support with the contention given by Mukhopadhyay et al. (2008).

From the results of the experiment, it was observed that the optimum doses of the nutrients, based on soil-test could help improving the yield of rice under the Terai alluvial situation of West Bengal. The results at different levels indicated the soil – test based fertilizer recommendation approach viable under the Terai situation of West Bengal. This is in support of the results obtained elsewhere by Bera et al. 2006. The experimental results showed that the primary (N-P-K) and micronutrients (Zn-B) had a significant influences on yield of rice. This suggested the need for applying all the limiting nutrients at optimum level for the yield maximization of rice. The absence of any of the applied nutrients would cause considerable yield loss to the crop.

Literature Cited

Acharya,C.L., Bishnoi, S.K. and Yaduvanshi, H.S. (1998). Effect of long term application of fertilizers and amendments under continuous cropping and soil physical properties in Alfisols. *Indian J. Agril. Sci.,* **58**: 509-516.

Ali, M. (2005). *Adequate potash improves rice production economics in West Bengal.*Copyright © 2007 International Plant Nutrition Institute. 655 Engineering Drive, Suite 110, Norcross, GA 30092-2837. United State American 770.447.0335 | F 770.448.04.

Bera,R.,Seal,A., Bhattacharya, P., Das,T.H.,Sarkar, D. and Kangoo, K. (2006) . Targeted yield concept and a frame work of fertilizer recommendation in irrigated rice domains of subtropical India. *J. Zhejiang Univ. Sci.*, **7** (12) : 963-968.

Jackson, M.L. (1973). *Soil chemical analysis.* Prentice-Hall of India Private Limited, NEW DELHI, INDIA.

Mukhopadhyay, D., Majumdar, K.,Pati, R. and Mandal, M.K. (2008). Response of rainfed rice to soil-test based nutrient application in terai alluvial soils. *Better Crops*, **92**: 13-15.

Saha, A.R. (1992). Ph. D. Thesis. Bidhan Chandra Krishi Viswavidyalaya, West Bengal.

Shukla, H. P., Shanker, H. and Pathak, R. K. (1983). Sulphur, zinc and boron nutrition of rai. *J. Indian Soc. Soil Sci.,* **31**(4): 517-520.

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